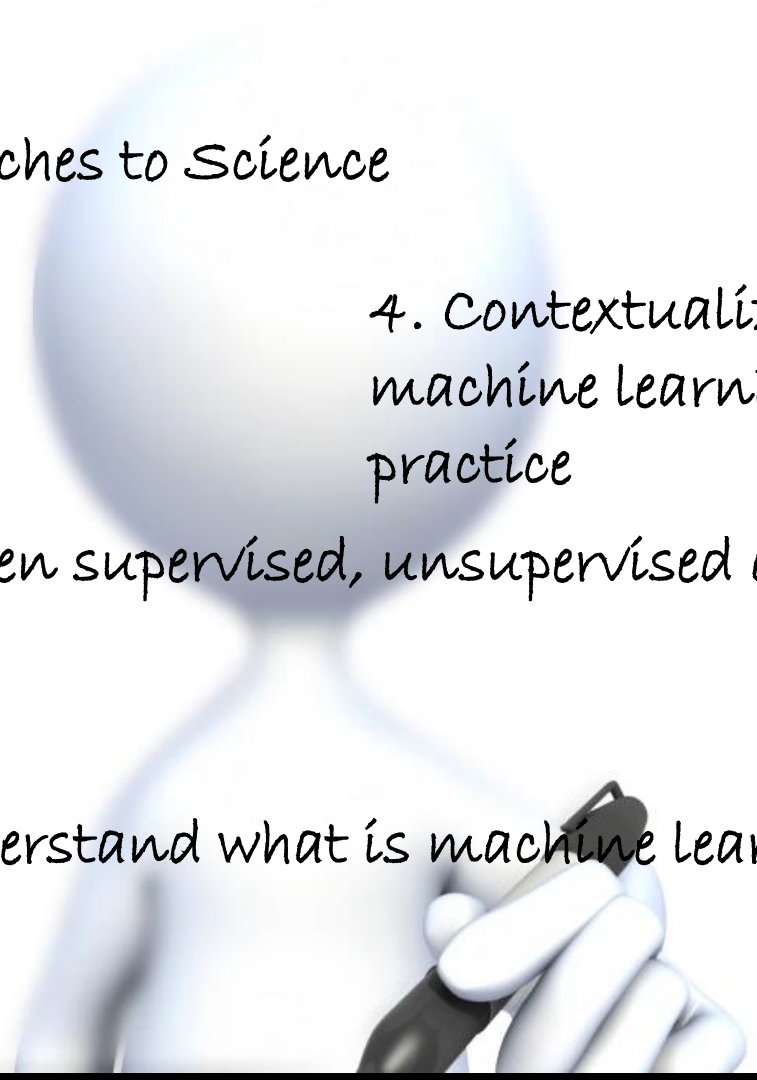
Topic 6 Machine Learning

From Traditional to Deep

AFIN8014 FinTech and Innovation



1. Review Approaches to Science

4. Contextualize the role of machine learning in financial practice

3. Distinguish between supervised, unsupervised and reinforcement learning

2. Understand what is machine learning

Learning Objectives

Two Main Philosophical Approaches to Science

Induction

Development of ideas through observation.

An Example

1.One marble from the bag is black.

2. Another marble from the bag is black.

3. A third marble from the bag is black.

Therefore, all the marbles in the bag are black.

Deduction

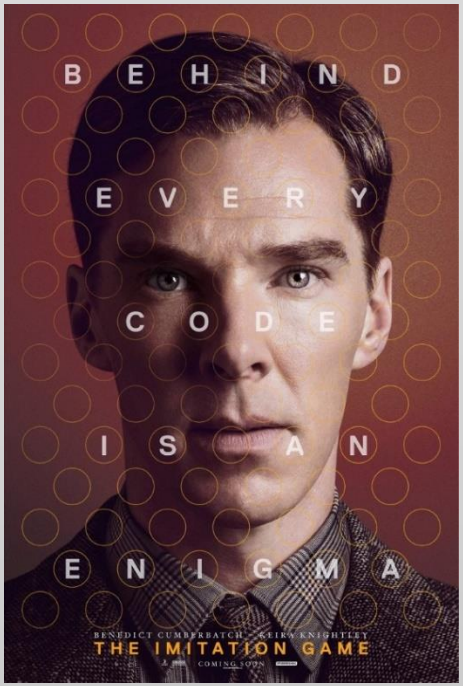
A way to explain a set of particular facts which is based more on the use of logic rather than observation. Validity of conclusion depends upon the premises.

An Example:

P1 All asset accounts have debit balances

P2 Inventory is an asset account

Therefore, Inventory has a debit balance.


BEHIND
EVERY
CODE
IS AN
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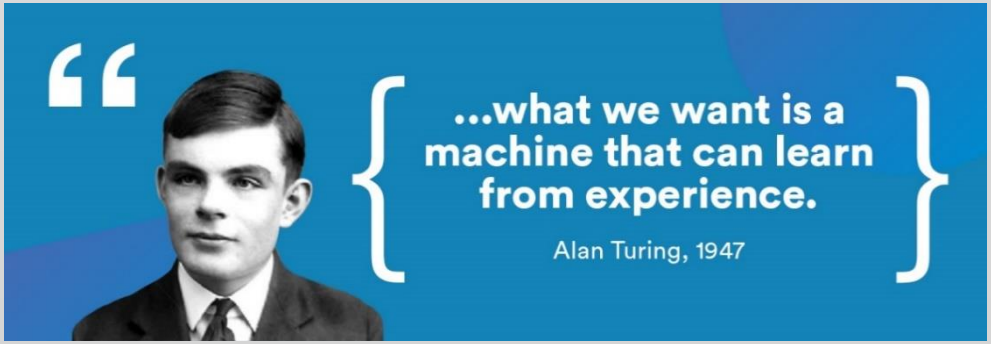
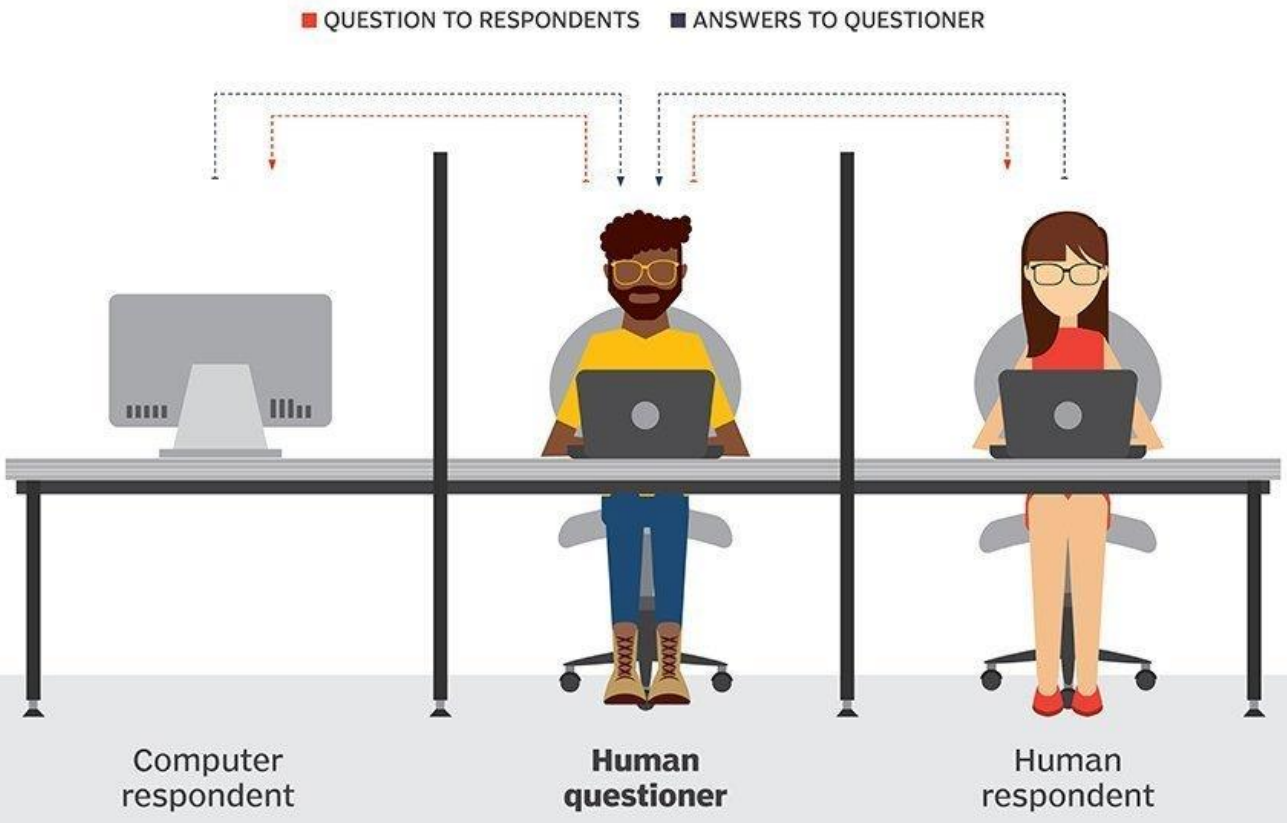
THE IMITATION GAME
COMING SOON


...what we want is a machine that can learn from experience.
Alan Turing, 1947


Can Machine Learn?

Turing test

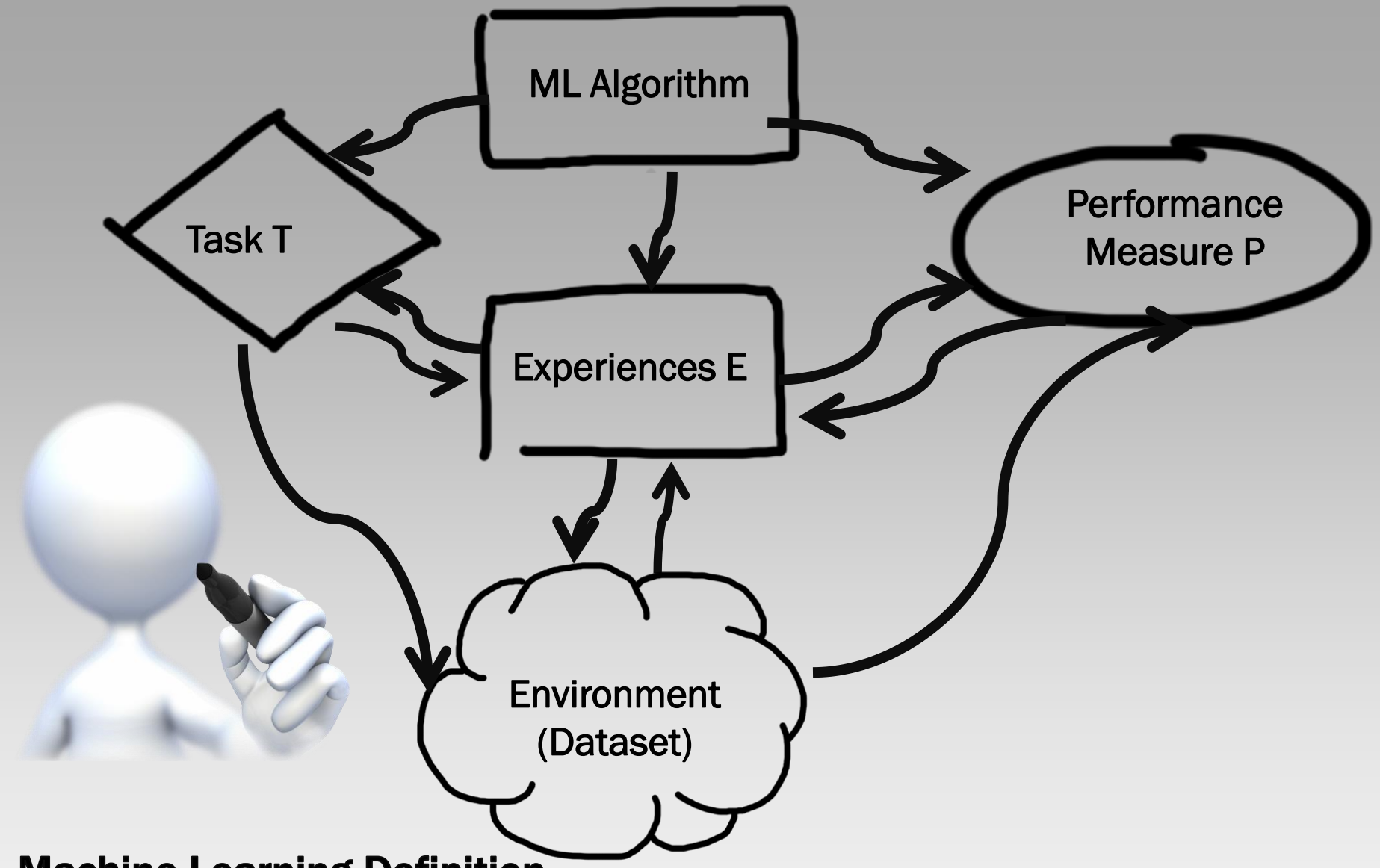
During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.



The Imitation Game of Human Brains

1. Enable computers to 'learn' over time.
2. Using algorithms and mathematical models to simulate neural networks of human brains
3. Allow computer to extract patterns of raw data rather than following specific instructions
4. Appearance of being closer to the activities of human brains

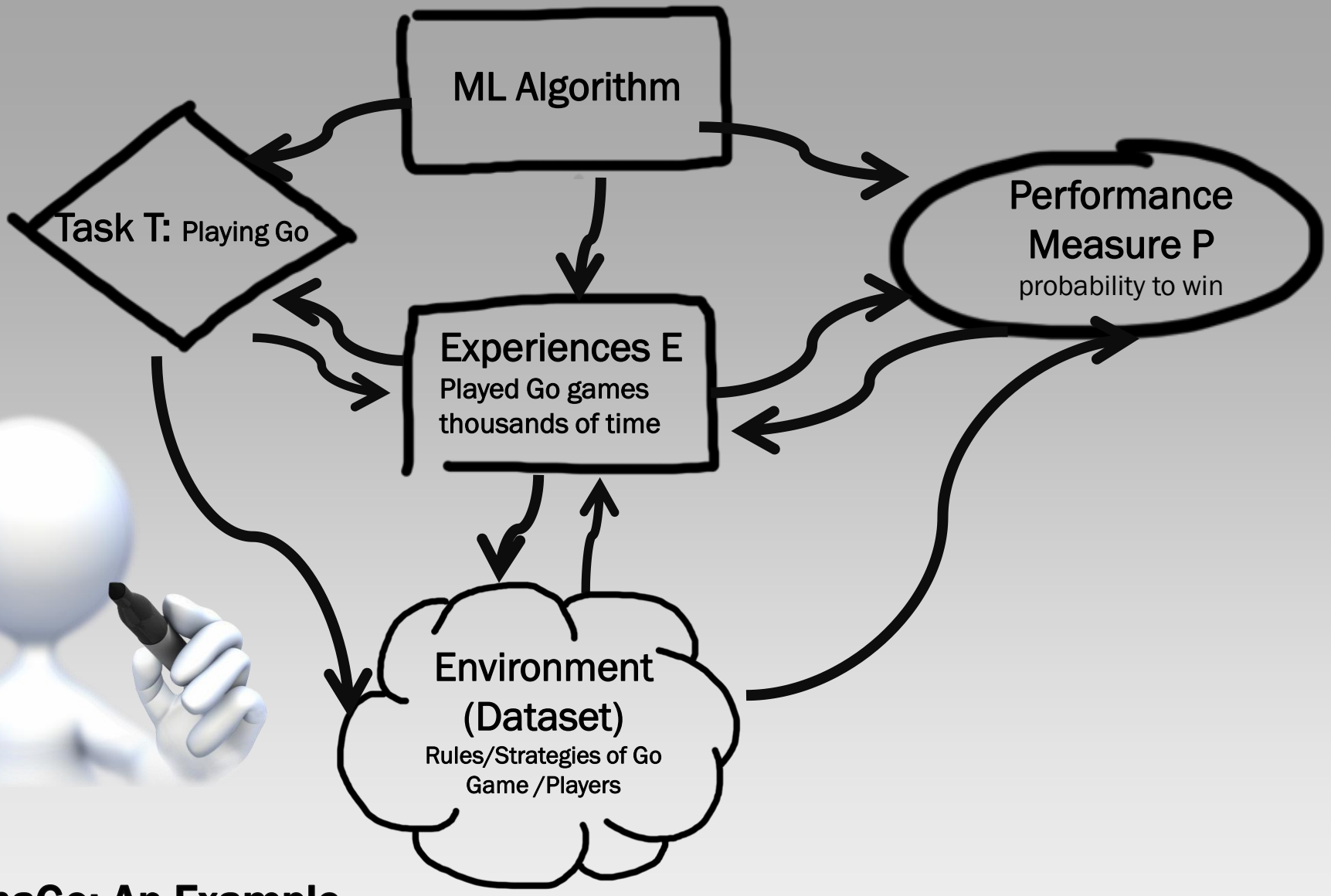
Machine Learning: core idea



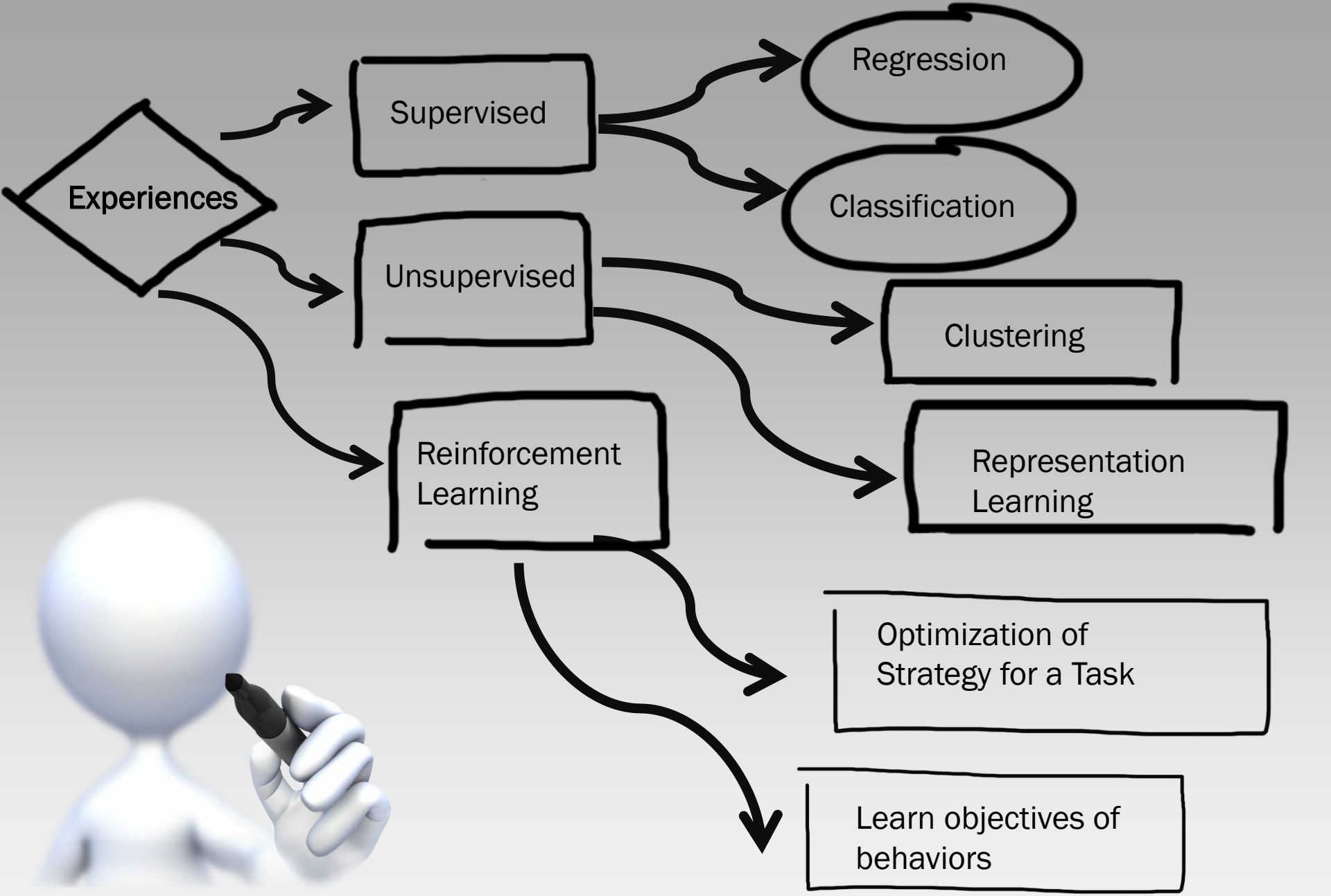
Machine Learning Definition

Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed. Arthur Samuel (1959).

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." (Mitchell, 1997)



AlphaGo: An Example



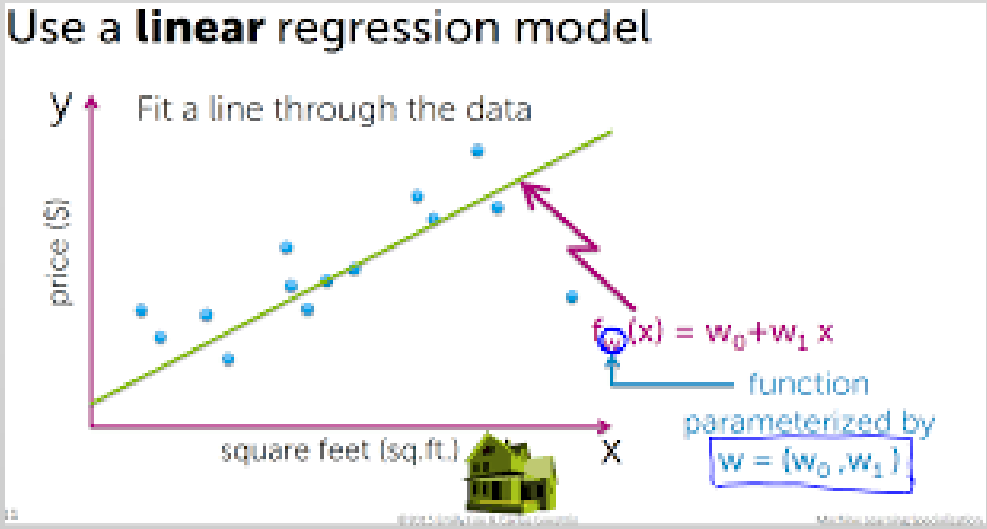
Machine Learning Landscape

Supervised: A Regression Problem

We gave the algorithm a data set in which the, called, **"right answers"** were given.

An example: predict house price

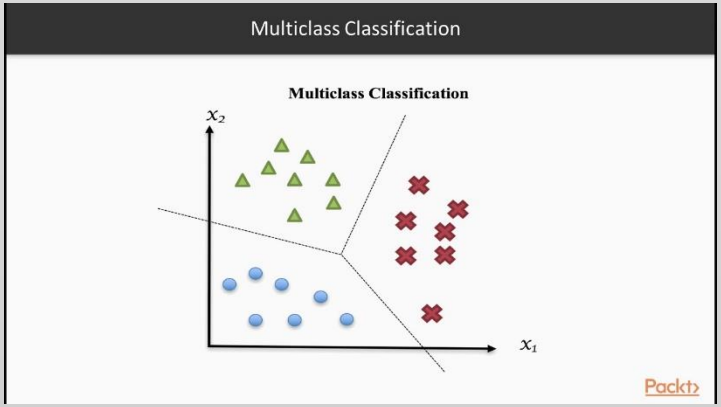
Typical Algorithm:
Linear regression



Supervised: A Classification Problem

we're trying to predict a discrete value output zero or one, malignant or benign.

It turns out that in classification problems, sometimes you can have more than two possible values for the output.



An example:

Spam detection

Typical Algorithm:

Logistic regression

Naïve Bayes

Decision Trees

Questions?

Examples of Supervised Learning in our daily life?

In finance?

Hint: most models you have learned in Finance are within this categories

Unsupervised: Clustering

Segregating data based on the similarity between data instances

An example:

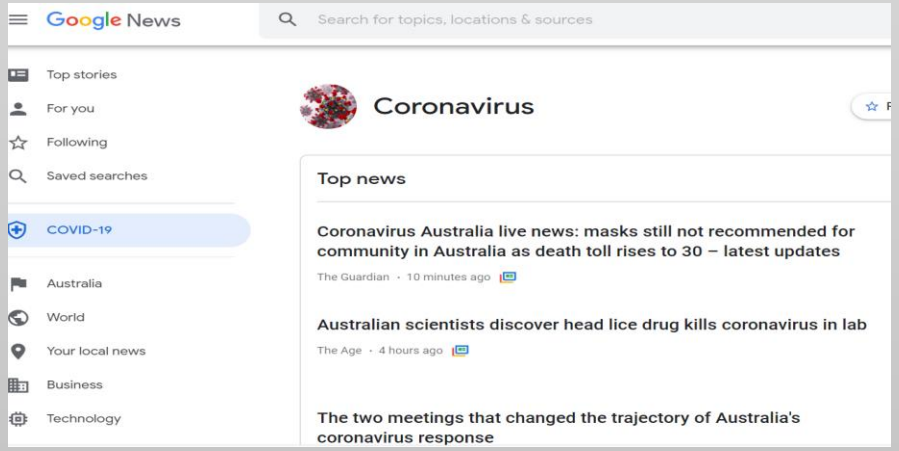
clustering websites based on particular words count on each webpage

Typical Algorithm:

K-Means

Hierarchical clustering

Hidden Markov Models



Unsupervised: Representation Learning

helps the system discover representations required to detect the features or to classify the raw data available.

An example:

A jigsaw puzzle

Typical Algorithm:

PCA

Factor Models

Dimension reduction

Fig. 1: What image representations do we learn by solving puzzles? Left: The image from which the tiles (marked with green lines) are extracted. Middle: A puzzle obtained by shuffling the tiles. Some tiles might be directly identifiable as object parts, but their identification is much more reliable once the correct ordering is found and the global figure emerges (Right).

Example source:
https://www.inference.vc/notes-on-unsupervised-learning-of-visual-representations-by-solving-jigsaw-puzzles/
Based on Noroozi and Favaro (2016) Unsupervised Learning of Visual Representations by Solving Jigsaw Puzzles

Questions?

Examples of Unsupervised Learning in daily life

In Finance

Reinforcement: Optimization

Learn how to attain a complex objective (goal) or maximize along a particular dimension over many steps.

An example:

AlphaGo: maximize the points won in a game over many moves.

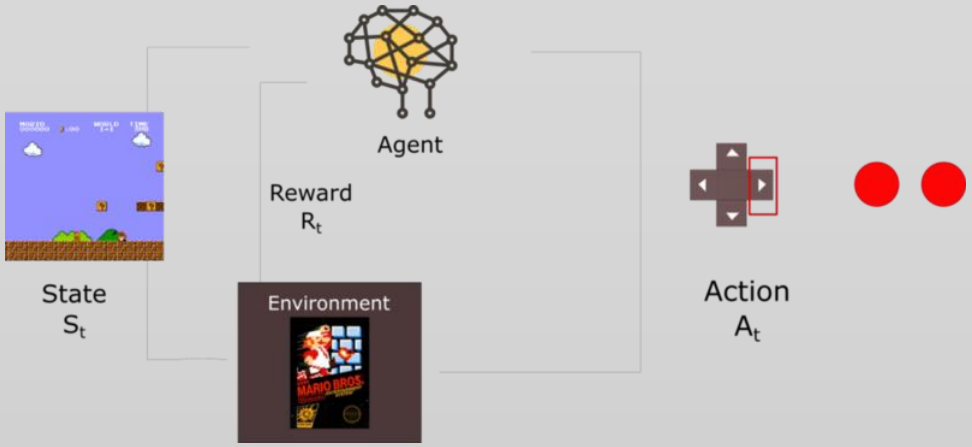
Super Mario Bros: MarI/O

Typical Algorithm:

Model-based RL

Model-tree RL

Neural networks



Picture source: https://www.freecodecamp.org/news/an-introduction-to-reinforcement-learning-4339519de419/

IRL: Inverse Reinforcement Learning

Learning an agent's objectives, values, or rewards by observing its behaviour.

An example:

OpenAI

https://openai.com/projects/five/

Typical Algorithm:

Model-based IRL

Model-tree IRL

Neural networks

Picture source: https://www.guidingtech.com/71032/openai-bot-beat-best-dota-player/ /

Questions?

Examples of Reinforcement Learning in daily life

In Finance